



**CALIFORNIA
ENERGY COMMISSION**



California Energy Commission
Clean Transportation Program

FINAL PROJECT REPORT

Compressed Natural Gas Fueling Station Project County of Santa Clara

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DISCLAIMER

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The County of Santa Clara's Compressed Natural Gas Fueling Station Project was a multi-year effort successfully completed in October 2015 thanks to the following, key professionals involved in the Project's management, funding, design, construction and commissioning:

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- Tie Feng, County of Santa Clara Project Manager
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- Jared Barber, Trillium CNG, Project and Design Engineer

PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation Program. The statute authorizes the California Energy Commission (CEC) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) reauthorizes the Clean Transportation Program through January 1, 2024, and specifies that the CEC allocate up to \$20 million per year (or up to 20 percent of each fiscal year's funds) in funding for hydrogen station development until at least 100 stations are operational.

The Clean Transportation Program has an annual budget of about \$100 million and provides financial support for projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.
- Improve the efficiency, performance and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Retrofit medium- and heavy-duty on-road and nonroad vehicle fleets to alternative technologies or fuel use.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce-training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

To be eligible for funding under the Clean Transportation Program, a project must be consistent with the CEC's annual Clean Transportation Program Investment Plan Update. The CEC issued PON-12-605 to support installation of new natural gas infrastructure and upgrades to existing natural gas infrastructures. In response to PON-12-605, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards March 18, 2013, the agreement was executed as ARV-12-043 on June 10, 2013.

ABSTRACT

The purpose of this report is to provide information on the County of Santa Clara's experience developing, constructing and operating its compressed natural gas fueling station, which was partially funded by the California Energy Commission. It includes the County's reasons for building the station, a description of project development, station technical information and station usage data during the first six months of operation. The information that comprises this report reflects the authors' experience developing the project; station technical and usage data was obtained through the project vendor as well as the compressed natural gas station's online business portal available to the County. Overall, the data supports the County's expectation for the station, which is that usage will start off gradually and increase over time, as more users become aware of it and the County increases the amount of compressed natural gas vehicles in its annual vehicle purchases. The County's main goal – which was to have a reliable and fully functioning compressed natural gas station under its control – was achieved, and the County now plans to leverage the environmental and fuel cost-savings benefits compressed natural gas vehicles have to offer.

Keywords: Compressed Natural Gas, Facilities and Fleet Department, Greenhouse Gas, Santa Clara County

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TABLE OF CONTENTS

	Page
Acknowledgements	i
Preface	ii
Abstract	iii
Table of Contents	v
List of Figures	vi
Executive Summary	1
CHAPTER 1: Project Background	3
The County of Santa Clara	3
Commitment to Sustainability	4
Sustainability in Fleet Operations	4
County Clean Vehicle Adoption Strategy	4
County CNG Fueling Station	6
CHAPTER 2: Project Approach	7
Solicitation Approach	7
Contract Approach	8
Design and Installation	8
Data Collection and Analysis	10
Station Throughput	11
Operational Issues	11
Duty Cycle of Current Fleet and Expected Duty Cycle of Future Vehicle Acquisitions	11
Specific Jobs and Economic Development Resulting from this Project	12
Fuel Source	12
Projects Carbon Intensity for Lifecycle GHG Emissions	12
CHAPTER 3: Goals and Objectives	13
Goal 1: Increase CNG Fueling Station Availability in Silicon Valley	13
Goal 2: Secure County-Owned CNG Fueling Station to Increase County CNG Vehicle Adoption	13
CHAPTER 4: Observations and Future Plans	15
Glossary	16
APPENDIX A: Station Throughput Charts	A-1

LIST OF FIGURES

	Page
Figure 1: Overhead image of Silicon Valley	3
Figure 2: Fluctuation of gasoline prices 2011 - 2015	5
Figure 3: Natural gas prices have been stable and low when compared to gasoline.....	6
Figure 4: Ribbon cutting ceremony at the County's new CNG station.....	7
Figure 5: Fencing and bollards protecting the station equipment	8
Figure 6: Overhead view of project site	9
Figure 7: CNG Fueling Station Key Equipment Used	10
Figure 8: CNG Fueling Station Usage Data for Period October 2015 thru March 2016	10
Figure 9: 2013 map of CNG stations in County of Santa Clara.....	13
Figure 10: Early 2016 map of CNG stations in County of Santa Clara.....	14
Figure 11: Monthly Throughput.....	A-1
Figure 12: Throughput Volume by Time of Day	A-2
Figure 13: Quantity of Fills by Fill Size	A-2
Figure 14: Fill Volume by Fill Size	A-3

EXECUTIVE SUMMARY

For several years leading up to the California Energy Commission's Program Opportunity Notice 12-605, the County of Santa Clara seemed to increase the use of compressed natural gas vehicles in its fleet, and by the public, due to the environmental and fuel cost-saving benefits they provide. However, without a compressed natural fueling station under its control and without the ability to fully fund a station, the County was hesitant to make a significant investment in compressed natural vehicles due to fuel availability concerns. At the time the County applied for its grant in early 2013, there were five fueling stations to serve the Silicon Valley region's businesses and 1.8 million residents. Several of these stations were open limited hours; customer filling queues and operational issues were not uncommon. As such, constructing and owning a compressed natural fueling station was a critical step for the County to reduce fleet-related greenhouse gas emissions and operating costs.

To develop the project, the County went through a multi-stage vendor solicitation/contracting and station design/construction process. Since commercial operation in October 2015, the public and the County have been fueling compressed natural vehicles at the station, including the County's five compressed natural inmate transport buses. From October 2015 – March 2016 123,247-gallon gasoline equivalents of compressed natural have been used at the station, or 673-gallon gasoline equivalents per day. It is the County's goal to convert 25 percent of its 2,500-vehicle fleet to compressed natural vehicles by 2025.

CHAPTER 1:

Project Background

The County of Santa Clara

This County, also referred to as "Silicon Valley," is located at the southern end of the San Francisco Bay (shown in Figure 1) and encompasses 1,312 square miles. The Santa Clara Valley runs the entire length of the County from north to south, ringed by the Diablo Range on the east and the Santa Cruz Mountains on the west. The County's population of 1.8 million is one of the largest in California, and the largest of the nine Bay Area counties. There are fifteen cities in the County, ranging from Palo Alto in the north to Gilroy in the south. San Jose is the largest city in the County, with a population of nearly one million, and is the seat for the County government. The County is renowned worldwide as a hub for technology and innovation, hosting companies such as Google, Hewlett-Packard and Apple.

Figure 1: Overhead image of Silicon Valley



Source: Santa Clara County

The County has formally committed to climate change sustainability. In 2007, the County's Board of Supervisors signed the Cool Counties Climate Stabilization Declaration and established the aggressive goal of reducing County greenhouse gas (GHG) emission by 80 percent before 2050. In 2009, the Board adopted the Climate Action Plan for Operations and Facilities¹, which focused on County actions that would reduce not only GHG emissions, but energy, water and fuel consumption as well. Since 2009, the County has installed approximately 6.4 megawatts of solar photovoltaic systems, 2.4 megawatts of fuel cells, intelligent battery storage systems and energy efficiency measures, such as light-emitting diode lighting, in several million square feet of County facilities. The County has an additional 11.4 megawatts of solar photovoltaic systems under contract and scheduled to be constructed and operational in October 2016. The County is currently ranked 21st on [Environmental Protection Agency's list for organizations, private or public](#), using the most onsite renewable energy generation nationally and can be found at <https://www.epa.gov/greenpower>. The County also received awards for its solar projects on the [Environmental Protection Agency website](#) at <https://www.epa.gov/greenpower#santaclara> and at the [Association of Bay Area Governments website](#) <https://abag.ca.gov/>.

In the County's Climate Action Plan, County fleet usage was identified as contributing GHG emissions of 22,706 metric tons of carbon dioxide per year, equal to 17 percent of the County's total emissions from operations and facilities. As such, fleet usage represented the third largest contributor of County GHG emissions, behind facilities operations (i.e. electricity and natural gas usage, 42 percent) and employee commutes (37 percent). With respect to fleet usage, the Climate Action Plan recommended a focus on clean and alternative fuel vehicles, such as electric and compressed natural gas (CNG) vehicles, in subsequent County vehicle purchases to reach the Board's GHG reduction goals.

In response to the County's fleet-related Climate Action Plan goals, the Facilities and Fleet Department (FAF) formulated a plan to adopt several types of clean vehicle technology, principally compressed natural gas (CNG) and electric vehicles. The rationale to diversify its planned investment in clean vehicle technologies rather than purchase just electric vehicles, for example, was based on:

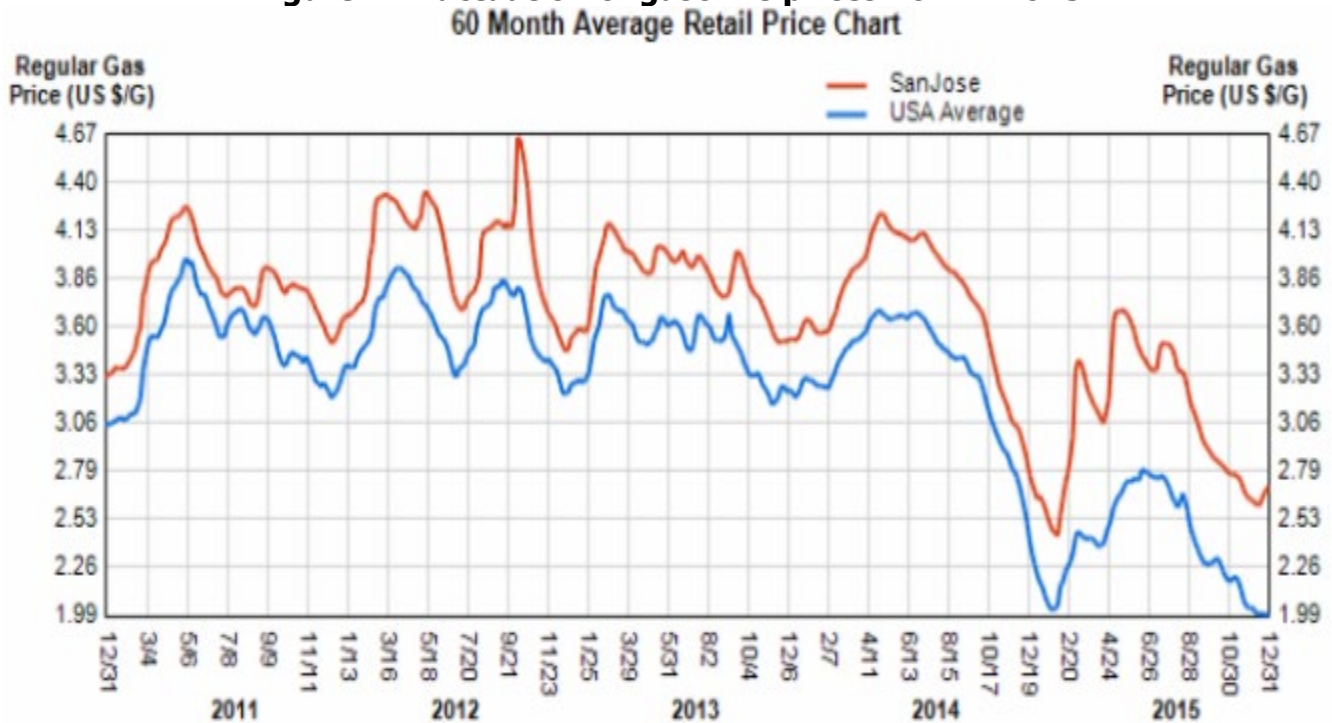
- The desire to avoid overreliance on a single technology/manufacturer in case such technology has significant and unforeseen future maintenance issues;
- The desire to avoid overreliance on a single type of fuel to reduce County's exposure to large fuel cost increases;
- The fact that certain clean technologies do not offer a full suite of cost-effective vehicle types; and

4

- The fact that certain clean technologies have performance and range limitations that would preclude them from serving certain County functions (e.g. law enforcement, emergency response).

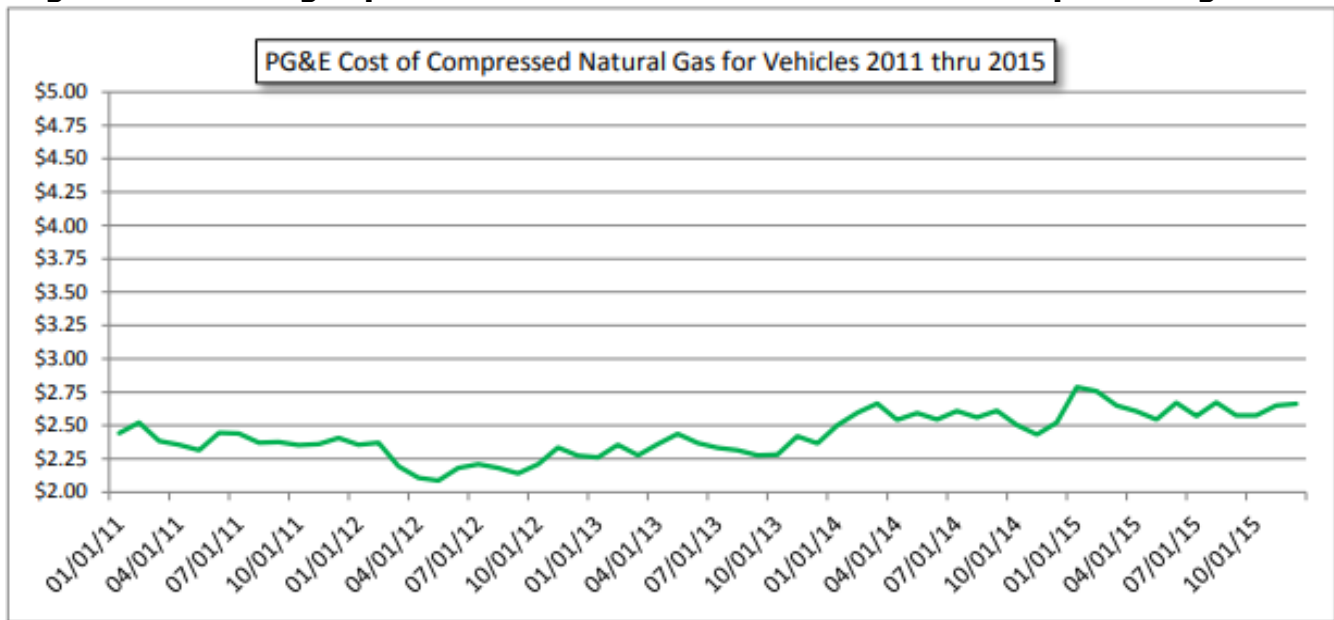
CNG vehicles were a technology that FAF was interested in including in its future, clean fleet since they were seen as a technology with similar range and performance capabilities as conventional vehicles, but one that would allow the County to reduce its fuel / operating costs and GHG emissions. It is estimated that a CNG vehicle emits 20 percent -30 percent less greenhouse gases, 95 percent less particulate matter and significantly less pollution than the equivalent gasoline or diesel-powered vehicle. Natural gas, as a fuel, has consistently been cheaper, and had a more stable price, than gasoline and diesel in recent years. As seen below in Figure 2, in San Jose, the price of gasoline fluctuated between \$4.67 and \$2.72 per gallon, with an average price over \$3.50 per gallon, from 2011 through 2015. Over the same five-year period, the price of CNG offered by Pacific Gas & Electric, the local utility in the San Jose area, has fluctuated between \$2.09 and \$2.79 per gasoline gallon equivalent (GGE), with an average price of \$2.44 per GGE.

Figure 2: Fluctuation of gasoline prices 2011 - 2015



Source: Santa Clara County

Figure 3: Natural gas prices have been stable and low when compared to gasoline



Source: Santa Clara County

After considering the risks and options associated with CNG vehicles, FAF determined that constructing a fueling station that would be County-owned, and that would have a reliable and consistent supply of CNG, would be a prerequisite to the County investing in CNG vehicles in a significant way. Adding a station to the region would also help to alleviate fuel availability concerns among private fleets and the public. However, without the ability to fully fund a CNG fueling station project itself, the County was in a holding pattern until such a time when it was able to access some source of partial, external funding. Once the County received its CEC grant in mid-2013, the County was able to implement its CNG Fueling Station Project, as described in more detail in Chapter 2.

CHAPTER 2:

Project Approach

Solicitation Approach

After finalizing project grant documents with the CEC, the County opened a competitive solicitation for design, construction, operation, maintenance and concessionaire services for a CNG fueling station for a ten-year period. The County opted to utilize a design-build solicitation, that was not prescriptive in terms of the equipment or station design, in an effort to not preclude a particular vendor, technology and/or design that would be able to fulfill the County's needs. The County did, however, specify certain features and performance capabilities that should be included in a proposed design, including:

- High rates of fast and continuous fill capabilities
- A design that included a new electrical service to the fueling station in order to clearly differentiate station electricity costs and costs attributable to the on-site building
- A station that possessed dual hoses/nozzles, one for heavy-duty and one for light-duty vehicles
- In designing the fueling station, the vendor should use the gas pressure of the pipeline at the project site, which the station would connect to (vs. a generic assumption)

The solicitation guidance above was included to ensure (1) proposers were making the same, realistic assumptions when pricing the project (2) the station would be able to accommodate significant future use by the County and the public and (3) the station operator, and not the County, would pay for the station's electrical costs, per the terms of the concessionaire agreement the County planned to enter into with the selected vendor (see Figure 4 below).

Figure 4: Ribbon cutting ceremony at the County's new CNG station



Source: Santa Clara County

Contract Approach

The County's CNG Fueling Station Project agreement with the selected vendor included services for the design, construction, operation and maintenance of the station. Of particular importance to the County was that the contract included long-term operation and maintenance services to ensure the station was built to a high degree of quality and the vendor would be knowledgeable with respect to future operation and maintenance issues. The County also opted to include a concessionaire element in the contract – where the vendor pays a fee for the right to manage and collect revenues from the station – to leverage the vendor's established protocols with respect to payment collection and specialized knowledge in fuel markets and station advertisement. Including a concessionaire element in the contract also serves as an additional incentive to the vendor to maintain the station in good operating condition.

Design and Installation

The CNG fueling station was installed at the County's Fleet Management Facility, located at 2265 Junction Ave, San Jose CA. Specifically, the dispenser, with dual hoses/nozzles, was located in the facility's front parking lot (see Figure 5), to the right of the front entrance of the facility from a street side vantage point (see overhead view of project site in Figure 6 on the next page). Vehicles can access the dispenser from the either of the site's two driveways. A canopy was built to cover the dispenser and protect it and customers from the elements. The station's compressor, storage vessels and gas dryer are located in a fenced area set back from the parking lot and dispenser to avoid any tampering or vandalism. Bollards were placed around station elements to prevent direct vehicle collisions.

Figure 5: Fencing and bollards protecting the station equipment



Source: Santa Clara County

Figure 6: Overhead view of project site



CNG customers can access the station from the left or right driveways.

All of the station's main components were pre-assembled offsite (see Figure 7 below for detailed list of key equipment), trucked into the project site and placed on pre-formed concrete pads built by the vendor. Once all station equipment was properly interconnected, the vendor worked with Pacific Gas & Electric, the local utility, to bring in gas and electric service to the station. At the County's request, the vendor left space for additional storage vessels and arranged electrical and gas connections to allow for additional dispensers should the County opt to expand the station in the future. Due to the pre-assembled nature of the station, onsite construction activity was relatively brief, lasting approximately 4 months. The station, which went live in mid-September 2015 and was open to the public starting in October 2015. It is capable of providing ten GGEs of CNG per minute for the first 50 GGEs of filling and three GGEs per minute continuously thereafter. It has usage and billing tracking software capable of providing daily data to the County through an online business portal. A telephone at the dispenser provides 24/7 technical support as well as emergency onsite technician support.

Figure 7: CNG Fueling Station Key Equipment Used

CNG fueling station key equipment:

- One (1) Ariel compressor with a 200 HP electric motor
- One (1) Hy-C Rapid Fill compressor
- One (1) Single tower gas dryer with on-skid manual regeneration
- One (1) Priority valve panel
- Two (2) 5,500 psi high pressure storage vessels arranged in a buffer configuration
- One (1) Dual-hose fast fill dispenser, which will include one (1) heavy-duty and one (1) light-duty hose / nozzle
- One (1) Card-based fuel management system
- One (1) Facility control panel and communication package, including sufficient emergency shut-down and other safety devices
- One (1) Air compressor
- One (1) 600 amp electrical distribution and motor control center
- One (1) Canopy

Source: Santa Clara County

The County's CNG fueling station was commissioned in late September 2015 and operated without significant issues for the subsequent six-month period. Figure 8 below lists key project metrics:

Figure 8: CNG Fueling Station Usage Data for Period October 2015 thru March 2016

Total Throughput Usage (in GGE)	123,247
Average Number of Vehicles Fueled per Day	13
Public Throughput per Day (in GGE)	623
Fleet Throughput per Day (in GGE)	42
Public Transactions per Day	11
Fleet Transactions per Day	2
Number of Hours that Station was Inoperative	4
Maximum Capacity of New Fueling Station (in standard cubic feet per minute)	415
Electricity Required to Power CNG Compression Equipment (kilowatt-hours per day)	750
Gallons of Gasoline or Diesel Displaced by Using Natural Gas	123,247
Emissions Reductions	
CO2	20%
Particulate Matter	95% (virtually no PM emissions from CNG combustion)
Non-methane hydrocarbons	80%
Nitrogen Oxides	50% (drop of .604 lb. /gal to .302 lb. /gal per epa.gov)
Formaldehyde	55% (drop from .049 lb. /gal to .022 per gal)

Source: Santa Clara County

Station Throughput

A series of charts, attached as an appendix to this report (Figures 11, 12, 13, and 14), show station throughput in a variety of contexts, including:

- Monthly Throughput
- Throughput Volume by Time of Day
- Quantity of Fills by Fill Size
- Fill Volume by Fill Size

In compiling this information, several trends became apparent:

- The vast majority of throughput (87 percent) at the County's station between October 2015 and March 2016 is attributable to a waste hauling company based in Monterey, CA (designated as "Monterey" in the charts). The County became aware that Monterey has a new fleet of CNG vehicles and is in the process of constructing its own CNG fueling station. To fuel its fleet in the meantime, Monterey was making several runs per day to the County's station, where it would fill several 100 GGEs of CNG. The County's reported throughput is therefore inflated as compared to a typical scenario.
- The majority of fills by the County / public are under 30 GGEs and occur between the hours of 6am and 7pm.
- In accordance with the situation described above, the data shows that Monterey has been logging fills typically measuring 30 to several hundred GGEs throughout a 24-hour time period.

Operational Issues

The station has been operating without significant issues. A minor issue occurred in early January 2016 when there was a temporary network issue, which resulted in the station not being able to receive credit card payments for several hours.

Duty Cycle of Current Fleet and Expected Duty Cycle of Future Vehicle Acquisitions

The County depreciates heavy duty vehicles on a fifteen-year straight line, and light duty vehicles on a five-year straight line. Buses are used to support mandates to transport inmates between correctional facilities and the courts. Given the weekly usage and adverse operating conditions, the equipment is expected to have a 20-year lifecycle.

Heavy Duty Vehicles

Given the maintenance requirements for a mix of emissions retrofit devices and new engine technology, the County expects to save \$0.15/mile, on average, in maintenance costs. This value is based on technician costs, garage overhead and parts.

Light Duty Vehicles

The County expects to purchase original equipment manufacturer vehicles consistent with conventional fuel models, thereby reducing the need to acquire a large variety of special parts. With the costs remaining the same, it is expected that the duty cycle for conventional fuel vehicles of 10 years would be consistent with the duty cycle of CNG vehicles as most original equipment manufacturer vehicles do not support parts production for vehicles older than 10 years.

Specific Jobs and Economic Development Resulting from this Project

Twenty-nine workers were employed for the construction of the CNG fueling station in positions including:

- Project manager
- Construction Specialist
- Millwright
- Carpenter
- Electrician
- Bricklayer
- Laborer
- Landscaper

A technician services and performs operation and maintenance activities on the fueling station on an on-going basis.

Fuel Source

The vendor, as station concessionaire, is responsible for supplying natural gas to the fueling station. The County closely follows biomethane opportunities and is considering developing a landfill gas-to-energy project over the next several years.

Projects Carbon Intensity for Lifecycle GHG Emissions

Carbon intensity of natural gas delivered by pipeline to California is approximately 67.70 carbon dioxide / Megajoules² and 94-71 carbon dioxide / Megajoules for current CNG fleet please see <https://ww2.arb.ca.gov/>. This represents an approximate carbon intensity drop of 28 percent.

² [Megajoules Definition](https://www.canstarblue.com.au/gas/megajoules-costs-explained/) <https://www.canstarblue.com.au/gas/megajoules-costs-explained/>

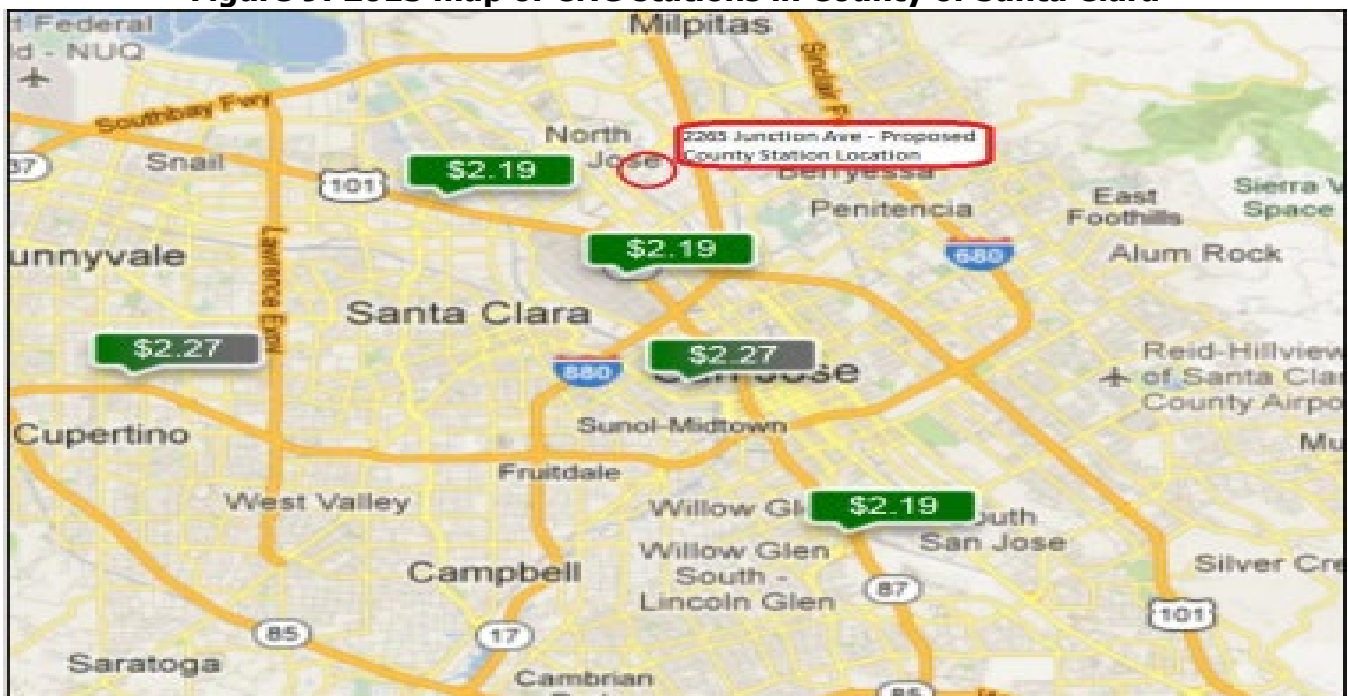
CHAPTER 3:

Goals and Objectives

Goal 1: Increase CNG Fueling Station Availability in Silicon Valley

Only five CNG fueling stations existed in the Silicon Valley (see Figure 9 below) at the time the County applied for its project grant in 2013. One of the main goals of the County's project was to increase CNG fueling options for private fleets and the public in the region in order to facilitate greater CNG vehicle adoption. With a fully functioning CNG fueling station complete and open to the public 24/7, the County has accomplished its first objective. This is especially important considering as of early 2016, the County's station represents the only new CNG station that has been added in the region in the last three years.

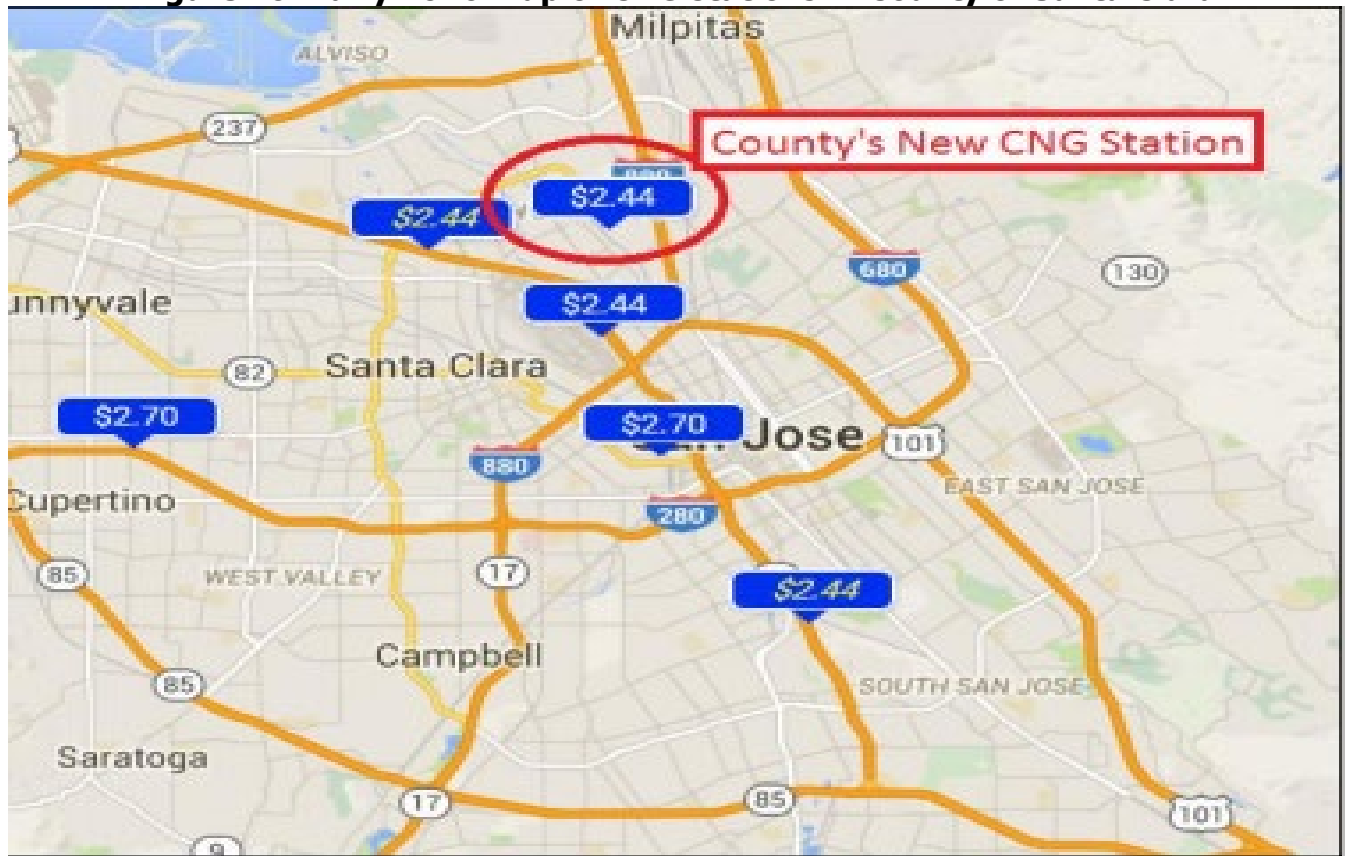
Figure 9: 2013 map of CNG stations in County of Santa Clara



Source: Santa Clara County

The second main goal of the County's project was to build a CNG fueling station (see Figure 10 on next page) that would be under the County's control and that would be able to provide a fast, reliable and consistent supply of CNG. Previously, despite the cost and environmental benefits of CNG vehicles, the County had been hesitant to make a significant investment in them due to fuel availability concerns. With the County station now operational, this is no longer an issue. In anticipation of the station coming online, the County already purchased three new CNG inmate transport buses in 2015 (for a total of five) and will be purchasing five new CNG Chevy Cargo Vans vehicles in 2016. The Facilities and Fleet Department's goal is to convert 25 percent of its 2,500-vehicle fleet to CNG by 2025.

Figure 10: Early 2016 map of CNG stations in County of Santa Clara



Source: Santa Clara County

CHAPTER 4:

Observations and Future Plans

The moderate usage the County has seen at the station to-date was expected since it will take some time for CNG customers to become aware of the County's station and for the County to ramp up its purchase of new CNG vehicles. Furthermore, the station has come online at a time when gas prices are at a five-year low, typically not a time when drivers and businesses look to alternative fuel vehicles, such as CNG vehicles, that might allow them to cut their fuel/operating costs. However, due to a large and stable supply of domestic natural gas supply for the foreseeable future, the County expects CNG vehicles to yield significant operating/fuel cost savings over their useful lives, while at the same time reducing GHG emissions. As the County fleet of CNG vehicles expands in future years, the County anticipates adding an additional dispenser and storage vessels to its station to facilitate faster and more frequent filling.

GLOSSARY

CALIFORNIA ENERGY COMMISSION (CEC)—The state agency established by the Warren-Alquist State Energy Resources Conservation and Development Act in 1974 (Public Resources Code, Sections 25000 et seq.) responsible for energy policy. The CEC's five major areas of responsibilities are:

1. Forecasting future statewide energy needs.
2. Licensing power plants sufficient to meet those needs.
3. Promoting energy conservation and efficiency measures
4. Developing renewable and alternative energy resources, including providing assistance to develop clean transportation fuels.
5. Planning for and directing state response to energy emergencies.

Funding for the CEC's activities comes from the Energy Resources Program Account, Federal Petroleum Violation Escrow Account, and other sources.

COMPRESSED NATURAL GAS (CNG)—Natural gas that has been compressed under high pressure, typically between 2,000 and 3,600 pounds per square inch, held in a container. The gas expands when released for use as a fuel.

FACILITIES AND FLEET DEPARTMENT (FAF)—This department serves as an internal resource organization, providing a full range of services to County departments and agencies, who offer vital resources and programs, to the public. FAF consists of capital planning, design, construction management operational management, Project management, lifecycle maintenance/repair of all vehicles and equipment, building security, and a wide mail and parcel processing/distribution system³.

GASOLINE GALLON EQUIVALENT (GGE)—The amount of alternative fuel it takes to equal the energy content of one liquid gallon of gasoline. GGE allows consumers to compare the energy content of competing fuels against a commonly known fuel—gasoline. GGE also compares gasoline to fuels sold as a gas (natural gas, propane, and hydrogen) and electricity.

GREENHOUSE GAS (GHG)—Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO₂), methane (CH₄), nitrous oxide (NO_x), halogenated fluorocarbons (HCFCs), ozone (O₃), per fluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

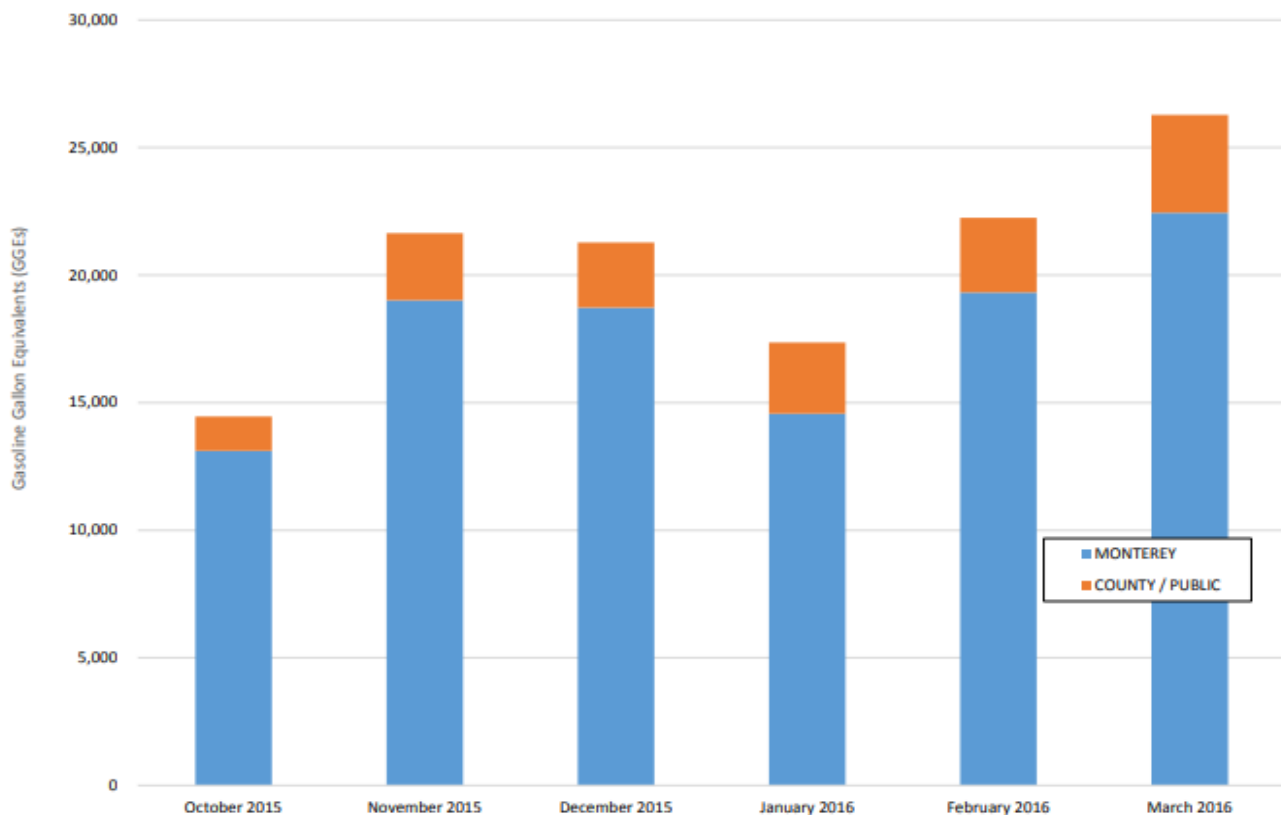
³ [The Facilities and Fleet Department Website](https://www.sccgov.org/sites/faf/Pages/home.aspx) <https://www.sccgov.org/sites/faf/Pages/home.aspx>

APPENDIX A: Station Throughput Charts

Below are Figures 11, 12, 13, and 14 that show station throughput in a variety of contexts:

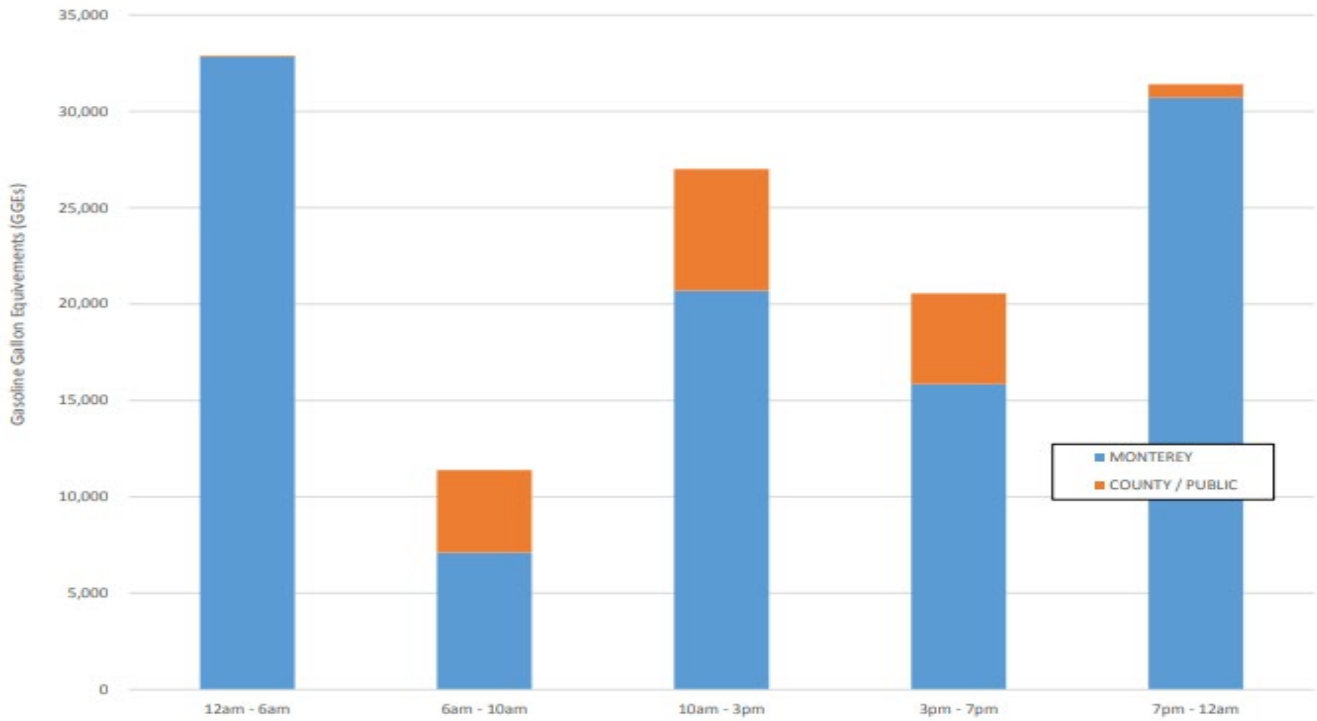
- Monthly Throughput
- Throughput Volume by Time of Day
- Quantity of Fills by Fill Size
- Fill Volume by Fill Size

Figure 11: Monthly Throughput



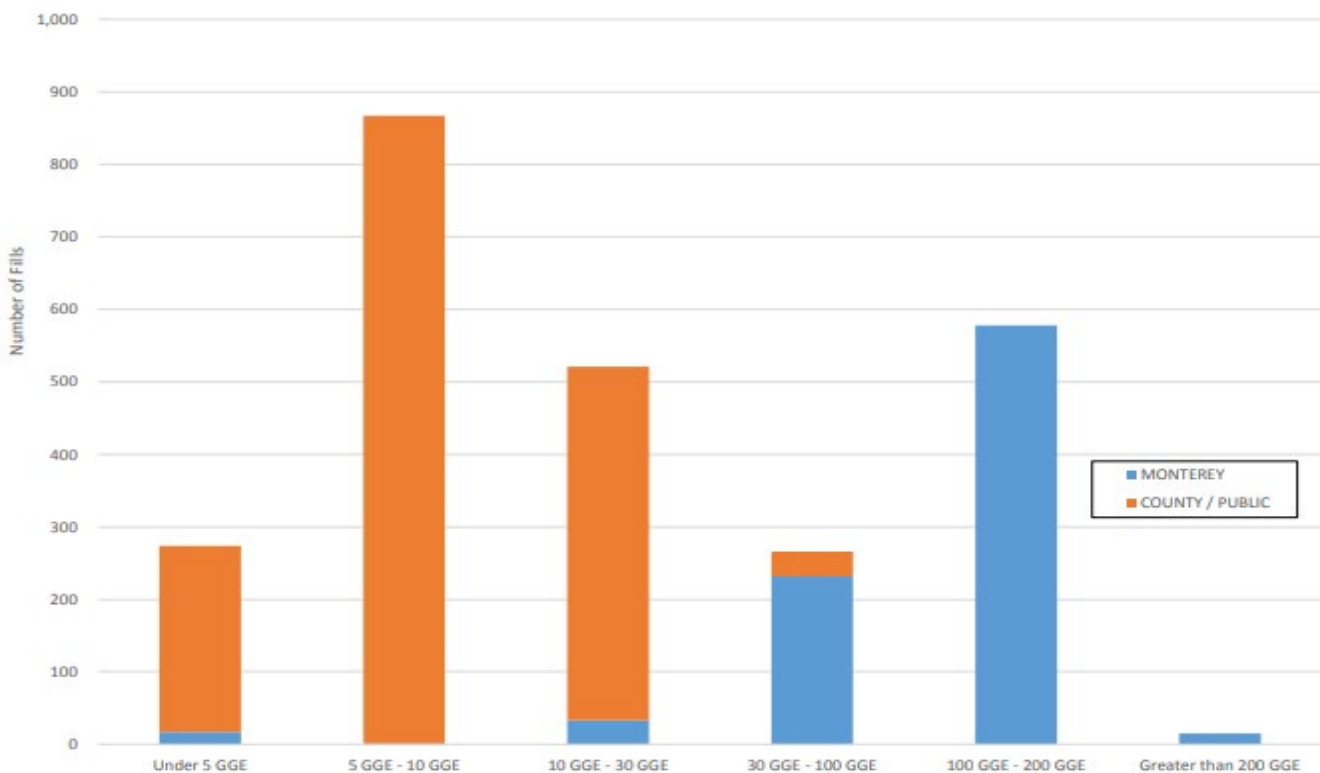
Source: Santa Clara County

Figure 12: Throughput Volume by Time of Day



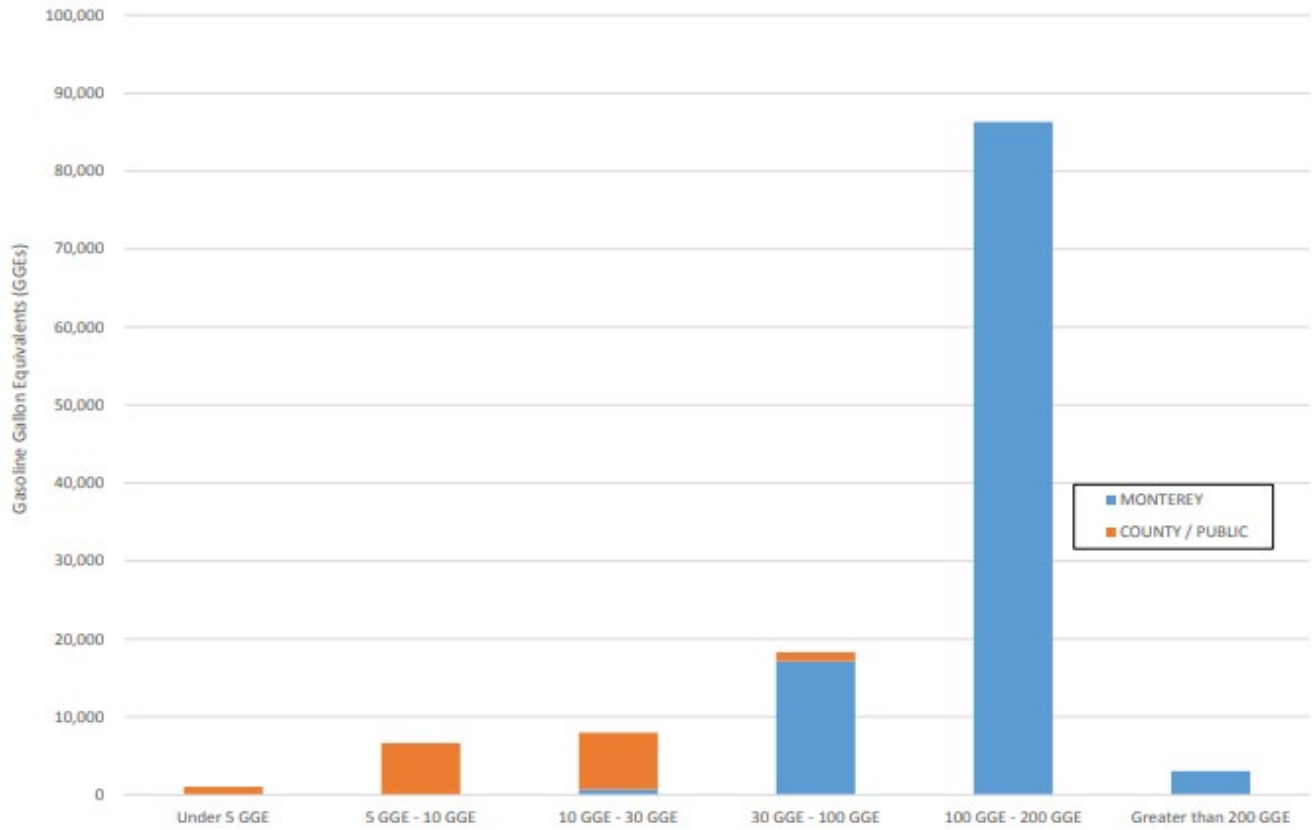
Source: Santa Clara County

Figure 13: Quantity of Fills by Fill Size



Source: Santa Clara County

Figure 14: Fill Volume by Fill Size



Source: Santa Clara County